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MEMO

To: Chip Humphrey and Kristine Koch, US Environmental Protection Agency (EPA),
Region 10.

From: Karl Gustavson and Paul Schroeder, US Army Engineer Research and Development
Center (ERDC)

Date: May 24, 2013

Subject: Review and Recommendations on Dredge Releases and Residuals Calculations from the
Portland Harbor Draft Feasibility Study.

Assumptions on dredging approaches have been developed in the FS to estimate contaminant releases and contaminated sediment residuals due to dredging. These residuals and releases are incorporated in chemical fate and transport model to depict the impact that dredging may have on sediment, water, and fish tissue concentrations. The assumptions are examined in this memo.

FS Information.

Dredging release and residuals processes are input to the contaminant fate and transport model.

Briefly:

Releases:

Areas: Locations are delineated by the SMAs for various alternatives.

Contaminant: 3% of the contaminant mass removed; 100% soluble.

Timing: The release occurs during the active construction season. The dredge area is broken into smaller units based on model grid cells. Dredging is scheduled for these grid cells and the release occurs during the time that grid cell is dredged.

Residuals (See Figure 1 for LWG summary):

Residual mass: 5% of contaminant mass in last dredge production cut

Residual concentration: Contaminant concentration of last dredge production cut

Residual management: 6" cover

Residual mixing with cover material: Cover contains 5% residuals by mass

Post dredging contaminant profile:



Top 6" = 5% of contaminant concentration in last dredge cut

6-9" = concentration of last dredge production cut

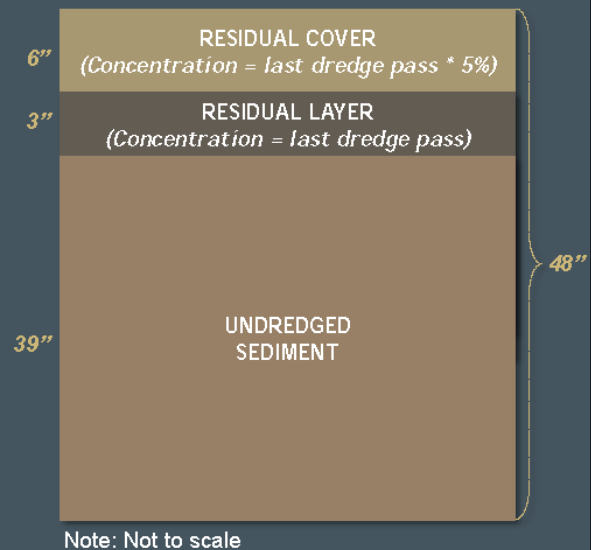
>9" = measured (or specified) concentration of sediments below dredge cut.

TOC concentration: Cover has the same TOC concentration as the sediment.

Figure 1: LWG explanation of Residuals Estimation Procedure. (Source 2013-06-05 Response to EPA Dredge Residuals Request.pdf)

Representation of Residuals in Fate Model

- "Reset" sediment concentrations in model to represent anticipated post-dredge conditions
- Specified 3" residual layer
 - Based on 4-ft dredge cut + 1-ft overdredge with 5% sediment loss
 - Concentration equal to deepest sample above the cut
 - Simple assumption to expedite model parameterization
- Specified 6" sand cover (per residual management approach)
 - Surface concentration equal to 95% reduction of residual conc.
 - Based on monitoring data from Duwamish River, Grasse River, Fox River, and Hudson River



Evaluation.

Releases: The 3% release estimate is derived from a compilation of release estimates from other sites (Table 6.2-12). The only parameters in this calculation are volume of dredged sediment, percent release of contaminant (3%), and percent of the release that is soluble (100%). The 3% value is consistent with historical dredging practices that have led to contaminant releases and elevated concentrations in exposed fish. These case studies led to recognition of the problem (e.g., Bridges et al. 2010) and an evolution and improvement in dredging procedures to lessen releases (e.g., Fuglevand and Webb 2012). Today performance has improved. For example, in 2012, the resuspension performance standard at the Hudson River Phase 2 was 2% and the far-field release rate from the Phase 2 Hudson River dredging was about 1 percent (Carl Stivers, 22-Apr-2013 email). Recent dredging at the Duwamish River Boeing Plant Early Action Area using state-of-the-art dredging approaches designed to reduce resuspension and residuals showed no exceedances of the Chronic Water Quality Criteria during dredging, indicating minimum releases (% release rate not determined). The empirical observations used to generate the 3% release value are from older projects with dredging practices not intended to manage releases and residuals. Resuspension of fine-grained sediment by the

dredge has been shown to be generally less than 1% as documented in the Technical Guidelines for Environmental Dredging of Contaminated Sediments (Palermo et al. 2008). It is now generally accepted that releases in excess of 1% are from other processes such as erosion and disturbance of the residuals, which can be controlled. The recent developments and improvements in practice indicate that a substantially lower release rate is achievable. Modeling in the FS that incorporates the high release values demonstrates the importance of implementing improved dredging and residuals management practices designed to lessen releases (e.g., FS Section 9.3.2).

Residuals: The concentration of contaminants in dredge residuals is dictated by the concentration of the removed material and the percent of material lost (or not removed) during dredging. The FS modeling described in Appendix Ha does not specify a loss or spillage rate (in contrast to Appendix Ib, which describes the residuals methodology specifies a 2 or 5% loss rate), rather it specifies a 3-inch residual layer remaining after dredging plus additional residuals that mixed throughout the cover. The 3" residual layer concentration is equal to that of the deepest sediment sample above the removed sediments.¹

After placement, the 6-inch residuals cap² is assumed to uniformly contain 5% of the concentration in the underlying residual layer due to mixing with that layer.³ This is an overly conservative assumption and would be strongly dependent on the method of cover placement. The assumption is more representative of a mechanical dump plopping the 6-inch cover in place en masse with momentum, rather than slowly building the cover by a spreading method. Mixing at other sites show mixing only in the bottom 2 inches of the cap (on average less than 1 inch), even with very soft materials and dredging residuals. Bioturbation should occur in the top 2 to 4 inches of the cover so it should not provide an additional mechanism to mix the residuals throughout the cover.

Site	Measured Mixing Depth (inches)
Anacostia River, Washington DC	1.6 average
Gasco Site Removal Action, Oregon	0.74 average
Lower Fox River Phase 1, Wisconsin	0.4 average
Port of Olympia, Washington	0.4 average
Silver Lake Pilot Study	1
Stryker Bay, Minnesota (dredged areas)	0 to 2
University of New Hampshire Contaminated Sediment Center – Pilot Cap, New Hampshire	1.5
West Branch Grand Calumet River	Average 0.2, Maximum 2

The contaminant concentration in sediments below the dredge cut is based on measured data, if available. If no data were available below the depth of dredging, then the left-in-place concentration was defined as the lower of either the RAL concentration for a particular alternative, or 50 percent of the last dredge pass concentration. The calculation of the residual layer is based on the relative proportions of generated residuals and underlying sediments. The residuals calculation does not appear to appropriately represent over-dredging in the clean up pass. Practically, the depth of the

¹ Note that a 3" residual layer equates to 5% of a nearly 6-foot dredge cut [if the density is unchanged, which would be appropriate for long-term modeling of residuals under a 6-inch cover] or 2% of a nearly 14.5 ft dredge cut, both of which are unreasonably deep cuts. Production cuts are not likely to be greater than 3-ft thick.

² Although Section 4 of the FS describes "placement of 1 foot of suitable sand post dredge cover."

³ Note that in Appendix Ib, the mixing calculation indicates the cover will contain 10% of the concentration of the residual layer due to mixing.

residual layer will not be known immediately following the last production pass to the neat line (depth of impact), so the cleanup pass cut depth will be set 1-foot below the depth of impact. Therefore, the cleanup pass will contain greater than one-foot of sediment, including the 1-foot cleanup pass (based on elevation of the DOI) and the overlying residuals. The concentration of the residual layer resulting from this last pass should be determined from a mixing of those materials and be used to determine the residuals.

Recommendation.

Releases: The release value should be set to 1% to reflect the recent experience in the Hudson River that incorporated strategies to lessen releases. While it is likely that even that value can be improved based on the Boeing Plant experience, the 1% value is a conservative indicator of releases (particularly combined with the worst-case conservative scenario that releases are 100% freely dissolved).

Residuals: The post dredge concentration should be determined by assuming a residual layer produced by 5% spillage from a 3-ft cut (or less, depending on dredge depth) to the depth of impact, followed by a 1-foot cleanup layer below the depth of impact (i.e., 5% spillage from a 1-foot of underlying sediment + the residual layer). The contaminant concentration in the residuals resulting from that cleanup pass should be calculated based on the contaminant concentration in the residuals from the production cut and the material below the depth of impact. If no data are available for the materials below the depth of impact, then 50% of the Alternative's RAL should be used because concentrations below the neat line will be less than the RAL and a 50% reduction at least recognizes that reality. If a data-based analysis is preferred, a value should be used that is based on cores with data above and below the DOI and calculating the percent decline of the intervals above and below the DOI, for the alternatives.

The residuals cover contaminant profile should reflect mixing in only the bottom 1 to 2 inches of the 6-inch cover. The concentration in the mixed zone is likely to range from 5 to 20% of the contaminant concentration of the residuals generated from the cleanup pass, as described above. A value of 15% is likely to be conservative.

New References.

Fuglevand, P.; Webb, R. 2012. Urban River Remediation Dredging Methods That Reduce Resuspension, Release, Residuals, and Risk. Proceedings, WEDA XXXII Technical Conference & TAMU 43 Dredging Seminar.